APPLICATION

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on

BURNER HEADS AND BURNERS

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Title: Burner Heads and Burners

Description of Invention

The invention relates to burner heads for the burning of fuel in the form of gas, vaporised liquid, or combustible pulverised /micronised solids including pre-mixes.

Many forms of burner and burner head for such fuels are known in the prior art. The form of burner head is determined by the form of flame required. For examples, they may comprise a nozzle if a simple single flame is required, or a tube with a plurality of holes in it along its length if a long flame is required.

Whatever the form of burner head it is important, if they are to function correctly, that the flame produced is of the kind required, predictable and stable and that there is a low risk of flash-back. For many of the prior art forms of burner these criteria are not easy to meet.

It is an object of the invention to provide a novel form of burner head which mitigates the above described problems.

According to a first aspect of the invention there is provided a burner head having a fuel inlet and a firing portion through which fuel flows to be burnt, wherein the firing portion comprises a plurality of spaced apart elongate elements with elongate fuel flow passages therebetween.

Conveniently the plurality of spaced apart elongate elements are formed of wire.

Preferably the wire is wedge wire having a generally triangular cross section oriented such that the fuel flow passages broaden out as the fuel flows through them to be burnt. Alternatively the wire is wedge wire having a

generally triangular cross section oriented such that the fuel flow passages narrow inwardly as the fuel flows through them to be burnt.

The firing portion may be generally tubular and formed of spirally wound wire secured to support members running axially of the tube, or formed of rings of wire secured to support members running axially of the tube, or formed of straight pieces of wire aligned axially and secured to generally circular support members running around the tube.

The support members may be located within the tube, or in the alternative may be located on the outside of the tube.

Where the firing portion is a tube it may be substantially parallel sided or it may taper along part or all of its length.

The firing portion may be generally planar and formed of straight pieces of wire aligned in a first direction and secured to generally straight support members aligned in a second direction substantially perpendicular to the first direction.

The firing portion may be reduced in area by masking selected fuel passages or selected lengths of fuel passages. This masking may be undertaken using a ceramic material.

Burner heads according to the invention may include a plurality of firing portions.

According to a second aspect of the invention there is provided a burner with a burner head according to the first aspect of the invention.

Embodiments of burners incorporating burner heads, and burner heads, according to the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 shows in cross section a conventional burner, incorporating a prior art burner head, of the kind used to provide hot air;

Figure 2 shows in cross section the same conventional burner as Figure 1, but incorporating a burner head according to the invention;

Figure 3 illustrates in partial cut away a close up of the tube portion of the novel burner head of Figure 2;

Figures 4 and 5 illustrate in partial cut away close ups of the tube portion of alternative forms of burner head in accordance with the invention;

Figure 6 shows a first alternative form of burner head in accordance with the invention in (a) sectional side elevation, (b) cross section along B-B; (c) cross section along C-C, (d) side elevation, and (e) plan view;

Figure 7 shows a second alternative form of burner head in accordance with the invention in (a) sectional side elevation, and (b) end elevation;

Figure 8 shows in partial sectional side elevation a third alternative form of burner head in accordance with the invention;

Figure 9 shows a fourth alternative form of burner head in accordance with the invention in (a) partial sectional end elevation and (b) sectional side elevation; and

Figure 10 shows in cross section substantially the same conventional burner as Figure 1, but incorporating a fifth alternative burner head according to the invention.

Referring first to Figure 1, a conventional burner 10, for provision of hot gases, comprises a fuel inlet 12 which leads via a fuel supply pipe 14 to a burner head 16. The fuel supply pipe 14 passes down the middle of a first chamber 18 which leads to a mixing chamber 20, the burner head 16 being located in the mixing chamber 20 adjacent to it's connection with the first chamber 18. The first chamber 18 has an air inlet 22, and the mixing chamber 20 has a hot gas outlet 24.

The burner 10 operates as follows. Fuel enters via the fuel inlet 12 and passes via the fuel supply pipe 14 to the burner head 16 where it is burnt on the

outside thereof. At the same time air enters via the air inlet 22 and passes through the first chamber 18 and into the mixing chamber 20, where it flows past the burner head 16. The air thus mixes with the fuel from the burner head 16 and combusts to produce hot gases (exhaust products) which pass out of the burner 10 via the hot gas outlet 24.

The conventional burner head 16 has a cylindrical portion 16a with a plurality of holes 16b around it's circumference, which form fuel passages through which the fuel passes to be burnt on the outside of the burner head 16. The burner head 16 also includes a substantially conical baffle portion 16c upstream of the holes 16b, which prevents the air from disturbing the flame to an excessive extent. The baffle portion 16c may include holes running through it generally parallel to the axis of the mixing chamber 20.

Referring now to Figure 2, in which parts common to Figure 1 are like referenced, a burner 30 is illustrated. The only difference by comparison to the burner 10 is the replacement of the prior art burner head 16 with the novel burner head 32. The fuel supply pipe 14 has a connector 34 at it's end adjacent the junction of the first and mixing chambers 18, 20. The burner head 32 is fitted into the connector 34.

The burner head 32 comprises a tube portion 32a and an end cap 32b. The tube portion 32a is formed from wire 36 as shown in Figure 3. The wire 36 is wound in a spiral and secured by welding to a plurality of support members 38, usually six (but this may be fewer or more then that), running axially of the tube 32, although it may be formed from a series of rings of wire rather than a spiral. The turns of the spiral or the rings comprise elongate portions of wire 36 and are secured to the support members 38 with gaps between them to provide fuel passages 40. The wire 36 is of substantially triangular cross section, generally known as "wedge" wire, such that the fuel passages 40 are narrowest at their start and broaden out as the fuel flows to the location where it is burnt, in this case flowing out of the tube portion 32 in a radially outward direction.

Other variations on the construction of tube portions of burner heads according to the invention are illustrated in Figures 4 and 5. Figure 4 shows a variation where the fuel flows in a radially inward direction and is burnt within the tube portion rather than outside thereof, the elongate portions of wedge wire 36' being arranged with their triangular cross section such that the fuel passages 40' get broader for fuel flow in that direction. Figure 5 illustrates that the support members 38'' may be located on the outside of the tube portion rather than the inside, and that the tube portion may be constructed from elongate portions of wire 36'' running axially rather than generally circumferentially of the tube, and the support members 40'' comprising rings rather than straight members. The manner of construction will be chosen as required for the application to which the burner head is to be put.

It should also be noted that burner heads in accordance with the invention may be constructed without tube portions, but instead with flat portions comprising a plurality of straight elongate wire portions secured to straight support members, with long straight fuel passages provided therebetween. Such a construction provides a generally planar firing area, and thus a sheet of flame. Indeed the burner head may be constructed of any general shape and still be in accordance with the invention.

The portions of the burner heads according to the invention over which combustion of fuel occurs comprise a plurality of elongate portions of wire secured to support members to provide a plurality of elongate fuel passages therebetween and may conveniently be called firing portions. These may comprises the total area formed of wedge wires, or only part of those areas as will become clear below.

The fuel passages 40, 40' or 40'' may have widths in the range 1 to 1000 microns. The fuel passages may be of constant width over a firing portion or may for example gradually decrease along the length of a cylindrical burner head if required to provide either constant heat output along the length (to

compensate for higher fuel pressure further from the inlet) or graduated heat output. This can be achieved particularly conveniently when the wedge wire is spirally wound to form the burner head.

Although the wedge wires 36, 36' and 36'' used to form the firing portions are described above as being of substantially triangular cross section they may also have other cross sectional shapes. It is however generally preferred that the fuel passages broaden out as the fuel flows through them to the location where it is to be burnt. The narrow start to the fuel passages provides a high fuel exit velocity and reduces the risk of flash back. The increasing width of the fuel passages means that the fuel slows quite rapidly which assists in flame retention adjacent the burner head. Thus the use of this form of burner head assists in providing a reliable stable flame with low flash back risk. However, in some circumstances the burner heads may be constructed with the wedge wire the other way around such that the fuel passages get narrower in the direction the fuel flows through them.

Referring now to Figure 6, a bar burner head 50 is illustrated. The bar burner head 50 includes a fuel inlet 52, an inlet pipe 54 and tube portion 56 which is connected to the tailstock 54 by means of connector 58, and has an end cap 60 at it's free end. The tube portion 56 is formed of wedge wire 36 generally as shown in Figure 3. In this case the wedge wire 36 is of the following dimensions: width of base of triangle 0.2mm, height of triangle 0.45mm; and the fuel passages 40 between the elongate portions of wire are 0.05mm in width at their narrowest point.

The burner head 50 is designed to provide a flame only on part of it's upper surface, and therefore a ceramic material 62 is used to mask off the lower half of the tube portion 56 and define the firing portion. A suitable ceramic material for this application is sold under the brand "Fibremastic", but other materials may be used as appropriate for the applications concerned.

In this embodiment a spark ignited pilot is provided. This comprises an igniter/flame detector 64 and a pilot area 66 formed from a piece of silicon carbide fibre matrix placed onto the tube portion 56 below the igniter/flame detector 64. The remaining surface of the tube portion 56 is masked off by the ceramic material 62 along this length, known as the pilot portion 56a. The remaining part of the burner head 50 provides a firing portion 56b over which a flame is produced, which comprises half the circumference of the tube portion along part of its length.

In the pilot portion 56a the fuel passes through the fuel passages and then through the silicon carbide fibre matrix 66 and is ignited by the igniter/flame detector 64. The fuel burns in and around the silicon carbide fibre matrix 66, which is thus heated and glows in the infra-red, this acts as a pilot for the burner head as a whole but without disturbing the flame thus produced.

For the burner head 50 fuel or a fuel/air mixture at a pressure of less than 2mb may be used to provide a heat output of 30kW, with a firing portion 56b of length of 1.57m when the tube portion 56 has a diameter of 0.2m.

The burner head 50, or other burner heads of generally the same form, may be used in the horizontal orientation in which it is illustrated, or alternatively in a vertical orientation, or any orientation therebetween. It is suitable for use in direct or indirect heating of ovens, furnaces, liquid boilers, vats etc. for examples, for heating, drying, cooking, browning, searing or flame washing in domestic, commercial or industrial processes.

Referring now to Figure 7, a second alternative burner head 70 according to the invention is illustrated. The burner head 70 comprises a fuel inlet 72, with a flange 74 around it for connection to a fuel supply (not shown). The fuel inlet 72 leads via a nipple 76 to an annular cross section plenum chamber 78. The plenum chamber 78 has a solid outer wall 78a and an inner wall 78b formed from wedge wire 36' as shown in Figure 4, to provide a firing portion. Thus fuel passages 40' are provided between the plenum chamber 78

and the void 80 in the centre thereof. The flame produced by the burner head 70 is thus cylindrical and inwardly directed into the void 80. If required portions of the inner surface 78b may be masked off to provide a firing portion of less than the whole of that surface.

The burner head 70 may be used in the horizontal orientation in which it is illustrated, or alternatively in a vertical orientation. It is suitable for use for examples, for heating, drying, cooking, browning or flame washing of wire, bar, tube, food products etc.

Referring now to Figure 8, a third alternative burner head 90 according to the invention is illustrated, incorporated within a burner 92. The burner 92 has a fuel supply pipe 94 leading to a fuel inlet 96 of the burner head 90. The burner head 90 includes a tube portion 98 formed of wedge wire 36 as shown in Figure 3, and a baffle 100. The burner head is located on an axial centre line of a circular cross section duct 102 through which air is passed in the direction of arrow D. The baffle 100 is provided to prevent the air flow from chilling the flame or causing instability thereof.

The fuel passes to the burner head 90 via the fuel supply pipe 94, passes out through the fuel passages 40 of the tube portion 98, which forms the firing portion of this burner head, and burns in the air stream passing over the burner head 90, and hot air passes out of the duct 102 as required.

As for previous embodiments, ceramic material may be used to mask some of the area of the tube portion to create a smaller firing portion, with flame provided only in desired directions.

The burner head 90 may be used in the horizontal orientation shown, or a vertical orientation, or any orientation therebetween, provided that it is co-axial with the airflow as illustrated. It is suitable for use in direct or indirect heating of ovens, furnaces, liquid boilers or vats, etc..

Referring now to Figure 9, a fourth alternative embodiment of a burner head 110, incorporated within a burner 112. The burner 112 has a fuel supply

pipe 114 connected to a fuel inlet pipe 116 of the burner head 110. The burner head 110 includes an elongate plenum chamber 118 which is oriented vertically, and off which branch a plurality of tube portions 120 in generally horizontal orientations to either side of the plenum chamber 118, to form a grid. Each tube portion 120 comprises a tube formed of wedge wire 36 as shown in Figure 3 with one end connected to the plenum chamber 118 and the second end sealed by an end cap 122, and thus the length of each tube portion forms a firing portion, and the total firing portion of the burner head 110 is large providing a very high output. The burner head 110 is located in a circular cross section duct 124, and has an igniter 126 provided adjacent the centre thereof.

Fuel passes from the fuel supply pipe 114, via the fuel inlet pipe 116 to the plenum chamber 118 and then into the tube portions 120. It passes out of the tube portions 120 through the fuel passages 40 and burns on the outside of the tube portions 120 in the air passing through the duct 124 as shown by arrow E, and thus hot air passes out of the duct 124 as required.

The burner head 110 may be used in different orientations, provided it is located in, and correctly oriented with respect to, a duct through which a suitable gas flow is passing, such that the fuel burns in close proximity to the firing portions of the burner head 110. It is suitable for direct incineration of VOCs. Odours etc., and heating, drying of flame washing in industrial processes.

Referring now to Figure 10, a burner 130 similar to the burners of Figures 1 and 2, and with like parts like referenced, but incorporating yet another form of burner head 132 according to the invention, is illustrated. The burner head 132 comprises a tube portion 132a formed of wedge wire 36 as shown in figure 3, and an end cap 132b. The tube portion 132a is masked off with a suitable ceramic material around the whole circumference along a mid section 132aa to provide a mixing portion, leaving a first firing portion 132ab

adjacent to the inlet fuel supply pipe 14, and a second firing portion 132ac adjacent to the end cap 132b.

The burner head 132 operates using primary and secondary fuel injection, as follows, to produce low nitrogen oxide (NOx) emissions. Primary fuel injection occurs when a small proportion of the fuel supplied passes through the fuel passages at the first firing portion 132ab, and is burnt in the air in the mixing chamber 20 at the start of the burner head 132. This combustion produces a quantity of NOx which stabilises as it travels along the mixing portion 132aa of the burner head 132. Secondary fuel injection occurs when the rest of the fuel supplied passes out through the fuel passages at the second firing portion 132ac and is burnt in the mixing chamber 20 at the end of the burner head 132. This secondary fuel injection maintains a fuel rich environment for as long as possible with combustion being completed as the addition of combustion air takes place in the mixing chamber adjacent the hot gas outlet 24.

The use of reburn technology is known in the prior art but has not previously been readily applied in such situations as this. The present invention makes the manufacture of suitable burner heads much simpler making the use of reburn technology simpler in a wide variety of applications. Thus more efficient and more environmentally friendly burner heads can be produced making it easier to meet the targets for lower emissions which are increasingly being set by regulatory authorities.

The burner heads described are examples only of what can be constructed in accordance with the invention. For examples tube type burner heads may be generally conical rather than cylindrical, burner heads with more than two firing portions along a length of tube may be constructed and burner heads including grids of firing portions may be much more complex than that shown in Figure 9, and so on. Generally burner heads in accordance with the invention may be designed to replace almost any prior art burner head.

In the present specification "comprises" means "includes or consists of" and "comprising" means "including or consisting of".

The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately, or in any combination of such features, be utilised for realising the invention in diverse forms thereof.